Volume 39 September, 1953 *Number 9*

Lubrication

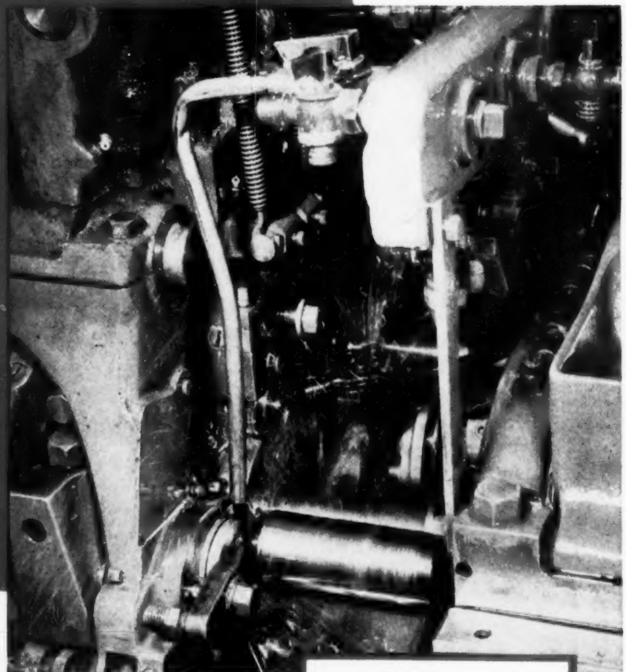
A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

AUTOMATIC SCREW MACHINES

PUBLISHED BY
THE TEXAS COMPANY
TEXACO PETROLEUM PRODUCTS

TOOL LIFE UP 20%



Job: Machining plunger pins for M48A3 fuse
Machine: Davenport Automatic
Metal: #416 stainless steel
Coolant: Texaco Cleartex Oil AX

...when manufacturer changes to TEXACO CLEARTEX OIL

Buchmann Spark Wheel Co., manufacturer of screw machine parts, Long Island City, N.Y., wasn't satisfied with the way a competitive cutting oil was performing on this job of machining stainless steel. Tool life was short, finish not all it should be. So they called in a Texaco Lubrication Engineer who recommended *Texaco Cleartex Oil.*

Improvement was noted immediately. Finish was much superior and tool life was increased some 20%.

Texaco Cleartex Oil is just one of a complete line of Texaco Cutting, Grinding and Soluble Oils designed to help you do *all* your machining better, faster, and at lower cost. A Texaco Lubrication Engineer will gladly help you get these results whatever the metal you are working or your method of machining it.

Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO REG. T.M.

TEXACO CUTTING, GRINDING AND SOLUBLE OILS FOR FASTER MACHINING

LUBRICATION

A TECHNICAL PUBLICATION DEVOTED TO THE SELECTION AND USE OF LUBRICANTS

Published by

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

Vol. XXXIX | September, 1953 | No. 9

Change of Address: In reporting change of address kindly give both old and new addresses.

AUTOMATIC SCREW MACHINES

THE fabrication of infinite varieties and endless quantities of finished and semi-finished parts from bar stock constitutes one of the greatest demands placed on the metal cutting industry today. Machine tool designers and manufacturers are successfully meeting the challenge by making available numerous types of machines for working on bar stock, each of which fulfills a particular need and is especially suited for certain specific applications. One of the most versatile and widely used machines and one which satisfies a multitude of diversified requirements is the Automatic Screw Machine.

Screw machines are similar to turret lathes in construction except that the head is so designed to hold and feed long bars of stock instead of castings or forgings. A variety of machining operations can be performed on both the end and side of the bar, and the machine movements are so actuated that identical parts are made continuously without the constant attention of an operator. Bars are fed into the machine, the machining operations are accomplished, and the finished parts are removed without being handled.

Automatic screw machines are not new. In fact they have been used to machine bar stock since before the turn of the century. However, the modern machines bear little resemblance to their predecessors either in appearance or application. The first Automatics were limited to the performance of the few simple machining operations necessary to produce small screw parts; hence the name "Screw Machines." By contrast, the present day machines can make practically any part that can be machined from bars of steel, iron, brass, copper, aluminum or any of the special alloy metals. It has been said that today's machine is a virtual production plant in itself. Figure 1 represents merely a few typical parts that can be produced. The name "Screw Machine" as applied to the present Automatics is much too limiting and not sufficiently descriptive to indicate the scope of operations that can be performed. Consequently some manufacturers are now identifying these machines by the more general term of "Automatic Bar Machines."

Standard models of Automatics are available for machining bar stock of all diameters up to and including 7¾ inches and of all shapes whether round, square or hexagonal. Some machines can turn out finished parts as long as 30 inches, although usually the length of the stock machined is appreciably less than that. There are two distinct classifications or types of machines, namely the *single spindle* and the *multiple spindle*. A brief discussion of the general operating principles of each follows.

Single Spindle Automatics

As the name implies, these machines work on only one bar of stock at a time. A bar up to 16 or 20 feet in length is suitably supported and extends through a hollow spindle, where it is held firmly by a collet. The machining operations are accomplished by cutting tools mounted on the turret and on the cross slides. The turret, or end tool slide, is directly opposite the spindle and normally will have five or six positions equally spaced around

Courtesy of The New Britain Machine Company

Figure 1 — Typical parts produced on an automatic.

its circumference for holding tools which perform cutting operations on the end of the bar. The cross slides, of which there are usually two on a single spindle machine, are located at right angles to the spindle and carry the tools which machine the side of the bar.

When the machine is operating, the spindle and the stock are rotating at a given, predetermined speed, and provision is made for quick reversal of the direction of rotation whenever the nature of the operation so requires. A specified length of stock is automatically fed through the spindle into the machining area, and the turret and cross slides move in from their positions to start the cutting operations. When the tool or tools located in the first position of the turret have finished their job, the turret withdraws from the bar, is indexed to bring the second tooling position in line with the work, and is again moved forward toward the bar so that the tools in this position can perform their operation. This process continues until the turret has indexed through all of its positions and all of the tools have contacted the stock. In the meantime, the tools held on the cross slides have been doing their job simultaneously with the end working tools. The movements of the cross slides to and from the work are independent of those of the turret but usually are so controlled that the side machining operations are completed by the time the last end working tool has finished its work. After the part has been completed, it is cut off, stock is again fed into the machining area and the cutting operations are repeated.

Multiple Spindle Automatics

Multiple spindle machines may have four, five, six or eight spindles spaced equally around a spindle carrier. As in the single spindle machines, long bars of stock supported at the rear of the machine pass through hollow spindles and are gripped firmly by a collet. The turret opposite the spindle carrier is equipped with as many tool mounting positions as there are spindles, and each position is such that an end working tool is in direct line with a spindle. The cross slides holding the side working tools are placed at right angles to the spindles. All machines will have at least four cross slides and those with six or eight spindles may have two additional slides.

With the single spindle machine the turret indexes around the spindle, bringing the end working tools successively in position to perform their

operations. When the tool or tools mounted in one position on the turret are working, those in the other turret positions are at rest. With the multiple spindle machines, the spindle indexes around the turret, carrying the bars of stock to the various end working and side working tools. In these machines each tool operates in only one position, but all tools are operating simultaneously.

For purposes of identification, the spindle positions are numbered consecutively in the direction of indexing, which may be clockwise on some machines and counter-clockwise on others. The position at which numbering begins also varies with different machine manufacturers. Stock is fed into the machine at a given spindle position, and as the spindle carrier indexes, the bar progresses from one tooling position to another. The end and side cutting tools at each tool position are so arranged that when the bar completes the circuit the machining operations on the part are completed. Each time the spindle carrier indexes, a part is completed and cut off, a new length of stock is fed into the machining area, and the other pieces in the spindle are in various stages of completion.

Two-Speed Operating Cycle

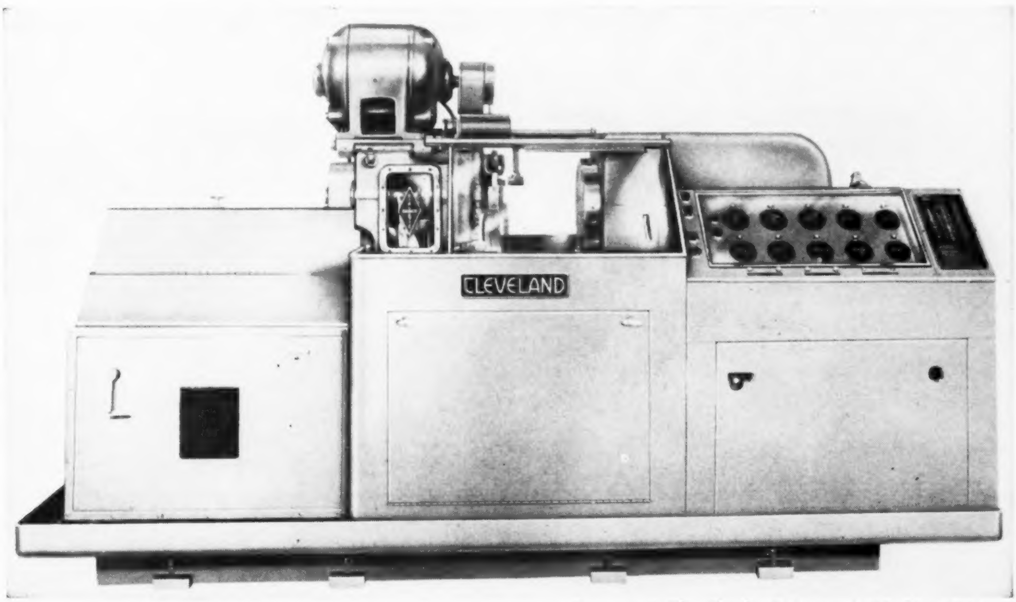
The operating cycle for both single and multiple spindle machines consists of two parts, a high speed cycle and a low speed cycle. The low speed cycle is the working cycle and begins when the turret and cross slides have advanced at high speed to within a hair of the point where the tools contact the stock. Immediately upon completion of the cutting operation the machine shifts into its high speed cycle. The turret and cross slides withdraw rapidly; the turret or the spindle carrier indexes, depending upon whether the machine is a single or multiple spindle; stock is fed and the turret and cross slides advance rapidly to the work.

Cutting Operations

Automatics are inherent high production machines but their most efficient utilization on any given job depends largely on a satisfactory tooling set up. This includes not only the proper choice of tools but also the most suitable arrangement of the sequence in which they are used. Coupled with this, of course, is the selection of the feeds and speeds best suited to the material being machined and the use of a satisfactory coolant. In the interest of the best overall production rate, the machine usually is tooled and operated so that the production cycle is as short as possible without imposing such a heavy load on the cutting tools that the machine must be shut down frequently to replace and regrind worn tools.

Several basic principles can be observed in tooling up an Automatic. From the foregoing discussion it is apparent that one of the features of these machines is that of taking *successive cuts* on a bar of stock. The combinations of successive machining operations that can be performed are almost infinite.

Another principle applied is that of taking *combined cuts*. This refers to the simultaneous



Courtesy of The Cleveland Automatic Machine Company

Figure 2 — A single spindle automatic.

operation of tools mounted on the turret and those held on the cross slide. For example, the side of the bar can be faced while the end is being drilled. Numerous operations such as these can be combined.

Multiple cuts can be made by virtue of mounting two or more tools on the same tool post. Drilling and facing and turning and centering are examples of pairs of operations that can be done from a common tool position.

One of the most important tooling features that can be used on the multiple spindle machines is that of *subdividing* a single cutting operation. This practice is employed to advantage when especially long operations are involved and results in decreasing the overall cycle and increasing production. For example, in drilling a three-inch hole in a bar on a four spindle Automatic, the tooling set up could be such that the hole could be drilled to a depth of one inch at the first position, two inches at the second position and three inches at the third position. The total time required to drill the hole by subdividing the operation in this manner is the time necessary to drill to a depth of only one inch instead of three inches.

These are some of the basic principles that can be applied to the tooling of an Automatic, and indicate the degree of flexibility that can be exercised. A detailed discussion of the individual cutting operations that can be done on these machines and of the steps involved in tooling a machine for a given job is beyond the scope of this article. Usually the turret or end slide is equipped with tools to perform such common operations as drilling, tapping, threading, centering, chamfering and turning, and the cross slides carry tools to accomplish such jobs as knurling, forming, facing and cut off. It is now almost standard practice for attachments to be included on or added to a machine which greatly increase the range of jobs that can be done.

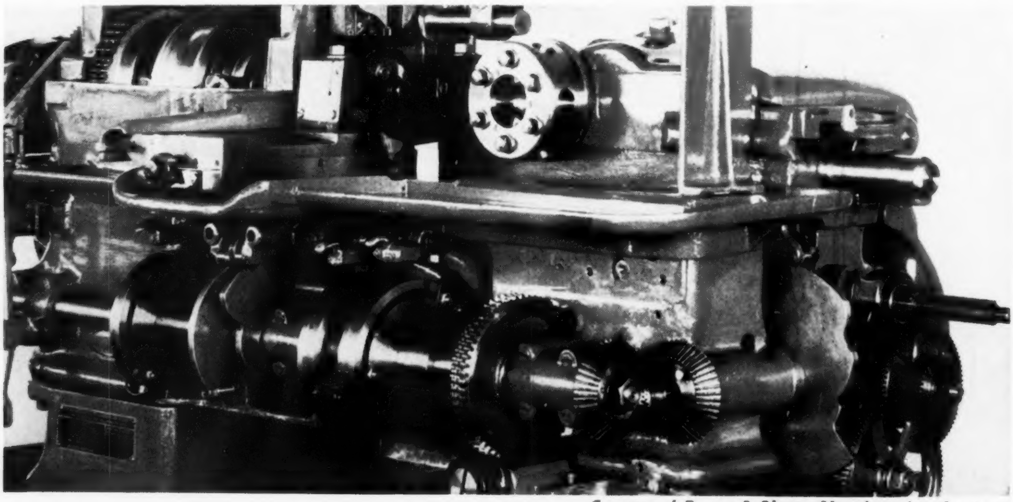
CONSTRUCTIONAL AND OPERATIONAL FEATURES

The various machine manufacturers exercise considerable ingenuity in the design and construction of their Automatics. Regardless of the make or type, however, all machines are designed with an eye to permanent accuracy and ease of job set-up. Time spent in tooling a machine, setting the speeds and feeds and making other necessary adjustments is non-productive time and in the interest of maximum production should be kept to an absolute minimum. The machines of today are being so constructed as to eliminate long, tedious set-up times. The high speed, or idling cycle, during which indexing of the spindles or turret, feeding of the stock, and movement of the tool slides to and from the work are being accomplished, also represents non-productive time and in the modern Automatics these movements are performed with unbelievable speed.

Despite variations in the details of construction and design that exist among machines of the various manufacturers, there are certain basic component parts and operational features that are common to all machines. A brief discussion of some of them will give a better insight into the nature of the machines and the manner in which they perform.

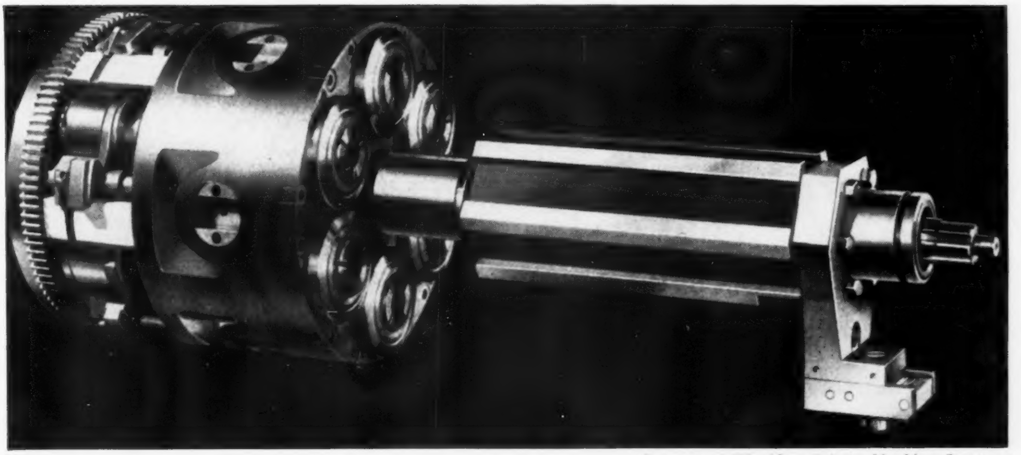
Frame

It has been said that the machining efficiency of an Automatic is more dependent on the design and construction of its frame than is any other type of



Courtesy of Brown & Sharpe Manufacturing Company

Figure 3 — Gearing of a single spindle machine.



Courtesy of The New Britain Machine Company

Figure 4 — Spindle carrier, stem and end tool slide assembly for a 6-spindle automatic.

lathe. Consequently the frames are usually constructed from rugged alloy castings to eliminate vibration obtained with heavy cuts and high speeds and to insure accurate performance, better finish and the maintenance of closer limits.

Large tooling areas are provided which permit free access to the tools and facilitate job set-ups and tool changes. This also allows ample space for coolant lines and enables the chips to drop rapidly from the machining zone and thus not interfere with the cutting operations.

Spindles

The spindles are made from precision ground, alloy steel tubes, and both ends are mounted on anti-friction bearings. All machines feature a wide range of spindle speeds and changing from one speed to another is accomplished readily by merely changing pick-off gears.

In the single spindle machine the use of automatic friction clutches permits reversal of the direction of spindle rotation and in some cases also allows as many as four different spindle speeds to be obtained with any one combination of pick-off gears.

With the multiple spindle Automatic, the spindle speed is constant for any given set-up and is the same for all spindles. The spindles may be driven from a central gear on the spindle drive shaft to gears on each spindle.

Spindle Carrier

In the multiple spindle Automatics the spindles extend through holes precisely and accurately spaced around a spindle carrier, which is made from heat treated and precision ground casting and is usually shrunk onto the carrier stem. Both the stem end and the carrier itself are mounted on heavy, firmly supported bearings.

Indexing of the spindle carrier through the various positions is accomplished by a modified Geneva mechanism driven by suitable gearing. This permits rapid acceleration of the carrier in going from one position to another but provides a smooth, shock-free stop. After each indexing the carrier is automatically locked in place so that it cannot move during the cutting operations.

Stock Feed Mechanism

Bar stock is fed into the machining zone during the high speed cycle, and the process is accomplished by co-ordinated activation of the collet holding the bar in the spindle, a feeding device which advances the stock through the spindle and a stock stop which accurately controls the length of stock fed.

Various types of spring collets located in the front end of the spindle and held by a nose cap can accommodate any shape of bar stock. The amount of tension which the collet exerts on the bar is easily adjusted.

Numerous means are employed to feed the stock. Usually a feed tube supported on long bearings is located in the spindle behind the collet and is attached to a friction feeding finger. The assembly is operated by a cam, and during the machining cycle it is drawn back over the stock and the feeding finger grips the bar. During the idling cycle the collet automatically opens and the feed tube moves forward, forcing stock through the spindle and against a positive stock stop, which insures accurate and reproducible feeding. The stop is cam operated and may be either the swing or the receding type. It moves into position during the high speed cycle, and after the stock has been fed, it moves out of the machining area so as not to interfere with the cutting tools. All of the movements associated with

DERMATITIS

"Dermatitis" is an inflammation of the skin. It can be caused by a large variety of materials and conditions, singly or in combination, but in this instance we are considering dermatitis that may arise from contact with cutting fluids.

Action of Cutting Oils on the Skin

Without adequate cleanliness and after continued exposure to cutting fluids the hair follicles and pores of the skin may become plugged, resulting in a condition resembling blackheads. The natural oils secreted by the skin and bacteria, found normally on the skin, accumulate under the blackheads and eventually develop into pustular eruptions or pimples; a so-called follicular dermatitis which is the most common type of oil dermatitis. Persons with hairy hands and arms are more susceptible to this type of involvement than are those with smoother and less hairy skins.

Petroleum oils have the property of defatting the skin which may cause drying with a tendency to cracking, and fissuring. The open cracks and fissures in the skin invite infection. Workers with naturally oily skins will not be as subject to this type of dermatitis as will those with drier skins.

Normally a well-designed cutting oil contains additional ingredients other than petroleum oil in order to obtain improved cutting performance. The exact nature and quantity of these additives are determined by the manufacturer of the cutting oil in order to obtain the best cutting performance and at the same time to avoid possible dermatitis from certain additives themselves.

After prolonged use, cutting fluids will contain many metal slivers which may become imbedded in or wound the skin, opening up avenues for infection. This is especially true when old, dirty towels and waste full of slivers are employed by the workman to dry or wipe the hands and arms.

Bacteria in Cutting Oils

Lubricating or cutting oils when refined by the manufacturer are free from bacteria. Bacteria are found, however, in air, soil, water, on one's skin, in fact almost everywhere. Bacteria, therefore, eventually find their way into cutting oil during use, which process, of course, is hastened when workers expectorate or throw refuse into the oil or the oil containers.

Cutting oils, as a whole, are not good culture media for bacteria. Bacteria will grow in animal or vegetable oils but hardly at all in mineral oil. Hence soluble oils, or insoluble oils having a high fatty oil content, will have, after long use, a higher bacterial count than will insoluble cutting oils which have a relatively low fatty oil content. However it is the insoluble type of cutting oil containing no fatty oil which gives rise to most of the dermatitis cases. This is further evidence that bacteria in the oil is not the primary cause of oil dermatitis. In fact, repeated laboratory investigations of samples of used cutting oils have revealed that the bacteria present in such samples were of non-pathogenic (harmless) type.

It is the germs normally present on one's skin which set up an infection under the oil blackheads as described above or which enter the skin and deeper tissues through breaks in the skin. Germs do not penetrate healthy skin, but if the skin is dry, chapped or fissured, or if it is abraided or punctured by the metallic particles in the cutting fluid or in wiping rags and waste, then infection may follow.

Rancidity of fatty oils develops with time, heat and use. Germicidal additives are sometimes incorporated in the manufacture of cutting fluids to inhibit bacterial growth and thus prevent or delay the cutting oil from becoming rancid. Such additives will not prevent dermatitis, and in certain instances they in themselves may cause dermatitis among workers sensitive to such products, or if used in concentrations strong enough to irritate the skin. Therefore, the users of cutting fluids should carefully investigate any antiseptics or disinfectants which they may wish to add lest they may further complicate the dermatitis problem. Rancid oil should be filtered, neutralized and heat sterilized, and if this does not clean the oil sufficiently for further use, it should be discarded.

In prevention of dermatitis the user should put *emphasis on cleansing the worker* rather than the oil for, if the worker will keep himself clean, the chances of skin disorders will be markedly reduced.

PREVENTION OF DERMATITIS

Cleanliness of Shop Personnel

Close attention to personal cleanliness is the best means of avoiding skin trouble. By frequent and thorough cleansing of the hands and arms with soap, brush, and warm water, accumulations of oil and dirt in the pores of the skin can be prevented.

Where workmen observe the following precautions, excellent results in the prevention of dermatitis have been reported.

1. Before beginning work, change from street clothes to shop clothes. When indicated, wear impervious armlets or aprons.
2. Before beginning work, at lunch time and when quitting work, wash with warm water and mild soap. Abrasive soaps should be avoided. Shower baths when quitting work should be mandatory when the skin of the body becomes oil-soaked.
3. Workers should not use kerosine or other oil solvents to remove oil or grease from their hands since solvents will defat the skin and may thus cause dermatitis or aggravate an existing dermatitis.
4. Workmen should put on clean working clothes at least once a week, oftener if necessary.
5. Workers should be particularly careful to prevent the clothing from becoming soaked with cutting fluid.
6. Splash guards attached to cutting machines and impervious armlets have been found quite effective in affording protection from flying chips and oil spray. Such guards, however, should be made of oil-proof material and should not be allowed to become dirty, loose, or ragged.
7. Clean wipe cloths should be given to the worker.
8. Spitting into drains or oil pans should be absolutely prohibited, as discharges from the mouth and throat always contain bacteria which will contaminate the oil.
9. The above protective measures are generally adequate. If protective creams of the barrier type are used they should be applied as directed. Persons with dry skins may find it helpful to apply a skin cream containing lanolin, or a vanishing cream, to the hands and forearms after washing up at quitting time in order to keep the skin supple.

Certain individuals are much more susceptible to skin troubles than others, just as some people are sensitive to pollens (hay fever) while others are not. New workers having skin trouble of any kind should not be assigned to jobs where they come in routine contact with cutting oils.

Cleanliness of Machines

Each machine on which cutting fluids are used should be cleaned frequently, and all sediment and deposits of old lubricant removed.

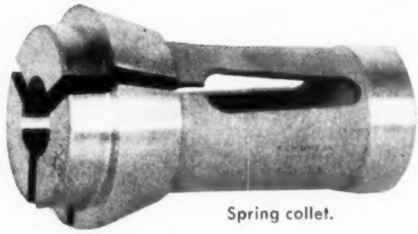
Reconditioning of Oils

Removal of the metallic particles is necessary to avoid injury to the skin. Ordinary filtration and centrifuging machines are not always capable of removing the minute metallic particles which may injure the skin. Where centrifuge or filter equipment is not available, heating will reduce the viscosity sufficiently to permit the metal to sink to the bottom of the tank or container. Replace oil regularly.

Handling of Dermatitis Cases

1. Send worker to the First Aid Room or to the plant physician upon the first sign of dermatitis.
2. Check to see if all preventive measures suggested are enforced.
3. If dermatitis is mild, he may return to his regular work; if it is severe, he may be temporarily transferred to other work where he will not come in contact with materials capable of causing dermatitis, or, if indicated, he should be given time off during the period of medical treatment.
4. After a severe dermatitis condition clears up, the worker may return to his regular job providing he observes the necessary preventive measures.
5. If the employe is allergic or sensitive to petroleum products or cutting fluids, he should be transferred to a department where he does not have such contacts. Such instances, however, will be relatively rare.


Feeding finger.


Spring collet.

Courtesy of Brown & Sharpe Manufacturing Company

Fig. 5

feeding the stock must be very rapid but at the same time they must be smooth and shock-free to prevent the stock from rebounding when it contacts the stop.

Turrets

The turrets in a single spindle machine are made of high alloy casting, accurately ground and fitted in large scraped bearings. Holes bored in the turret are fitted with clamped bushings to hold the cutting tools. Smooth and rapid indexing is accomplished by a Geneva mechanism, and the horizontal motion to and from the bar of stock is controlled by cams.

The turret in a multiple spindle Automatic is usually mounted on the spindle carrier stem and thus forms an integral unit with the spindle assembly. This assures permanent alignment of the turret with the axes of the spindles. In addition, the turret is further supported by a rugged guide arm which travels on a heavy guide plate. The horizontal motion is activated by cams or by intermittent gearing with clutches to shift back and forth from the high and low speed cycles.

The length of travel during the cutting cycle is easily fixed, and to insure accuracy and reproducibility, the turret operates against a positive stop.

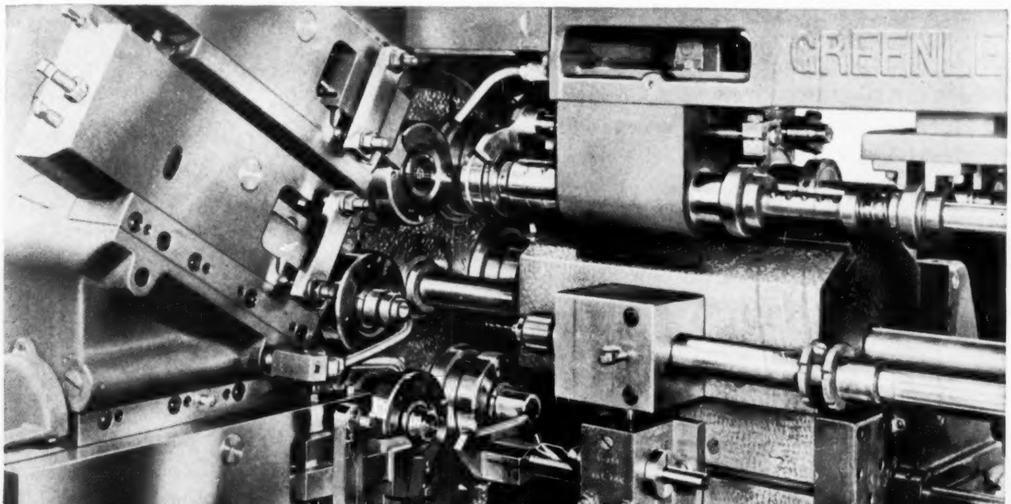
Cross Slides

The cross slides are wide and long, of rugged construction and are mounted in such a manner that the bearing surfaces are protected from chips and grit. Their movements are controlled by cams and the operation of each cross slide is separate and apart from that of the other cross slides and also from that of the turret. The length of the cutting stroke is easily set, and like the turret, the cross slides operate against a positive stop.

The multiple spindle machine will always have four cross slides and sometimes as many as six. It is general practice to use the lower slides for heavy work such as forming and the upper slides for finishing cuts. This reduces the chance of having finishing operations interfered with by falling chips.

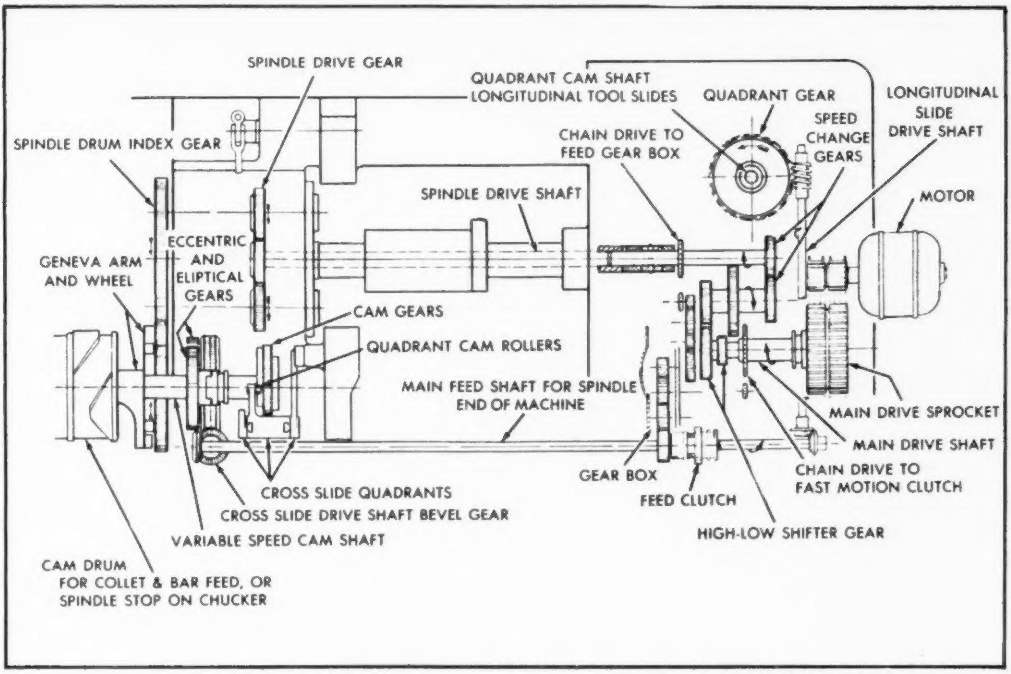
Operating Mechanisms

From the foregoing discussion it is apparent that the mechanics of actuating, controlling and coordi-



Courtesy of Greenlee Bros. & Company

Figure 6 — Close-up of tooling area on a 6-spindle machine.



Courtesy of The Warner & Swasey Company

Figure 7 — Sketch of power train for a 5-spindle machine.

nating all of the motions involved in the operation of an Automatic is no simple matter. An inspection of the inner workings of a machine reveals a network of gears, shafts, clutches and cams. Although variations exist in methods employed to drive the machines, the following general description may be considered as typical and representative.

Power may be applied from a motor to a pulley drive shaft with either a V belt or a chain drive. The pulley drive shaft then operates the work spindles and the main drum shaft through suitable gears and auxiliary shafts.

The main drum shaft will usually contain the drums, cams and gears necessary to control all tool movements, indexing, stock feed and timing of the various operations. During the machining or low speed cycle it is driven through the feed change gears. During the idling time, or high speed cycle, it is driven direct from the pulley drive shaft through a constant speed shaft.

The spindles, on the other hand, are driven at a constant speed throughout the whole operation by the pulley drive shaft through spindle speed change gears and the spindle drive shaft.

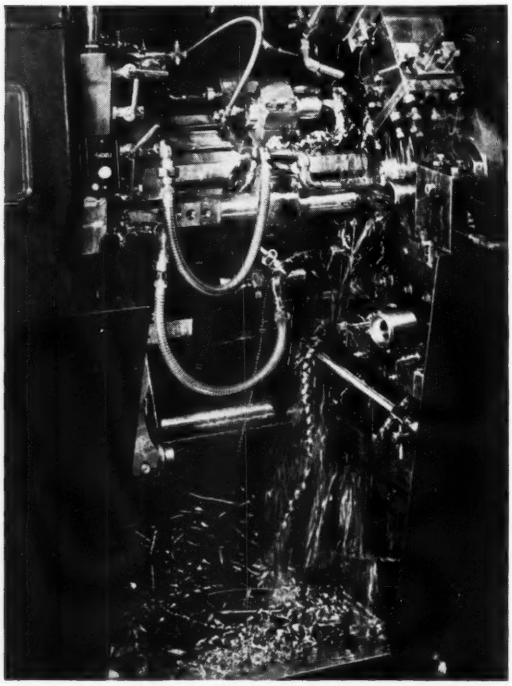
COOLANT SYSTEM

Successful operation of an Automatic, including long tool life and satisfactory finish, depends to a large extent on the proper application of a suitable coolant. The coolant is pumped from a reservoir located in the base of the machine and is distributed to each cutting tool through a manifold system with flexible hoses. In addition to the regular low pressure outlets, some machines are equipped to supply the coolant at high pressure for use in such operations as deep hole drilling.

Equally important as the selection of the right coolant is the provision for a copious flow applied to the proper spot. The coolant will be of little value unless it can get to the areas where the tool and workpiece are in contact, and extreme care should be taken to assure that the coolant is so directed. Also frequent checks should be made to see that the position of the flexible hoses has not been disturbed.

The coolant, together with the metal chips, cascades back into the reservoir and is recycled. The inlet of the pump is protected from chips and other foreign particles by a screen. Most machines are so designed that a mechanical chip conveyor can be installed to remove the chips continuously from the reservoir. Where a mechanical conveyor is not employed, the chips are removed periodically by hand. For most satisfactory results, good cleanliness practices as applied to the coolant systems cannot be over-emphasized. A regular schedule should be established for cleaning the reservoir, and whenever a change is made in a coolant, the whole system should be thoroughly cleaned.

The coolant used will depend for the most part on the type of metal being machined and the nature of the cutting operations. The transparent type cut-



Courtesy of The National Acme Company

Figure 8 — Close-up of a 6-spindle machine in operation — showing flow of coolant.

ting oils seem to be preferred on the Automatics and there are such products available which will be satisfactory for most of the jobs.

Soluble oils can be used but extreme caution should be observed in applying them. Frequently there may be leakage of lubricating oil into the coolant system or leakage of the coolant into the lubricating system. In a machine where one or both of these conditions exists to any degree, a soluble oil emulsion should not be employed. Contamination of the lubricant with water can have very disastrous results and should always be avoided, and contamination of an emulsion with lubricating oil may eventually cause the emulsion to break and separate. Leakage conditions of the type mentioned are most prevalent in machines built before 1945. However, before using a soluble oil emulsion as a coolant, it is most advisable to check the condition of the machine involved regardless of its age.

Another factor to be considered when using a soluble oil type coolant is the lubrication of the cross slides and turret. Some machines rely on the cutting oil itself to lubricate these parts. In such cases special provisions should be made for the lubrication of these moving parts as the soluble oil emulsions usually will be inadequate.

LUBRICATION

In order for the Automatics to turn out finished products rapidly and accurately on a continuous basis, all parts of the machine must function properly. One of the most important factors contributing to satisfactory performance is effective lubrication, without which accuracy may be lost, misalignment of parts may occur or metal to metal contact may be such as to cause rapid wear or complete seizure between moving parts. The manufacturers of Automatics have recognized the importance of efficient lubrication, and have equipped their machines with centralized systems which assure positive lubrication for most of the moving parts.

Types of Central Lubricating Systems Used

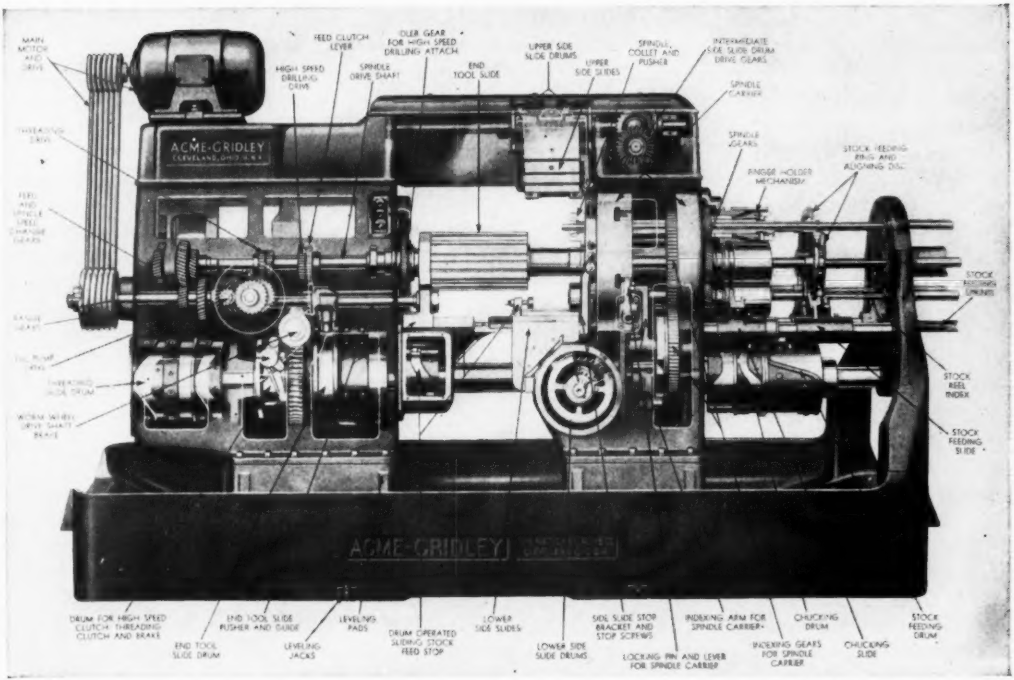
Usually each machine will have two types of centralized lubricating systems built into it, namely flood lubrication and metered lubrication.

A simple flood or cascade system is commonly employed to lubricate the parts in the head stock, including the simple drive gears, clutches, antifriction bearings, feed gears and drive chains. The oil is pumped from a reservoir in the base of the head stock through a filter and is directed through drilled passages and tubing to the parts to be lubricated. The oil bathes the parts and returns to the reservoir for recycling.

Continuous and cyclic metered lubrication may be used for most of the other moving parts of the machine. With the continuous method the system is under slight pressure and individual metering units permit oil to flow at a given rate to each part to be lubricated. Each meter unit contains a filter to remove any foreign particles from the oil and the size of the orifice determines the rate at which the oil is fed. Thus, by making a proper selection of meters each part can be lubricated in accordance with its own requirements and wasteful over-lubrication can be prevented. The oil for both the continuous and cyclic metering application is pumped from separate reservoirs from those containing the oil used for flood lubrication.

The cyclic portion of the metered lubrication system operates at higher pressure and permits a shot of oil to pass through the meter at regular intervals, usually 20 or 30 minutes apart.

Although the central systems provide for automatic lubrication of most of the moving parts, there are certain locations such as the motors, pumps and some isolated sections which are not included and which require special attention. These may be lubricated with either grease or oil, applied periodically such as once a day or once a week. The lubrication of these parts is essential for satisfactory operation of the machine, and the manufacturers recommendations should be followed closely. As already mentioned, special precautions should be taken to assure adequate lubrication of the tool slides when a soluble oil emulsion is used as the



Courtesy of The National Acme Company

Figure 9 — Construction features of a 6-spindle machine.

Courtesy of Bijur Lubrication Corporation
Courtesy of The Warner & Swasey Company

Figure 10 — Metered lubrication system on a 5-spindle automatic.

coolant. A good water repellant grease will be most suitable for such cases.

Requirements for General Machine Lubricant

Experience has demonstrated conclusively that, for machines equipped with anti-friction bearings and precision gears and operating at high speeds and with close tolerance, the use of "quality" lubricants reduces maintenance costs and improves performance. This is particularly true where there are centralized lubricating systems and the oil is recycled.

A main factor contributing to short oil life and poor performance is oil oxidation. The ultimate products of oxidation are gum, varnish and sludge and their effect can be serious and costly. By the use of an oil containing an oxidation inhibitor, the life of the oil will be greatly increased and the system will be kept free from gum, sludge or varnish.

Another factor detrimental to the inner workings of a machine is rust formation, which is particularly troublesome in humid weather. Premium grade oils contain additives to protect the machine from this undesirable condition.

Foam formation caused by air being beaten into the oil can also be a nuisance on occasions but is reduced to a minimum when "quality" lubricants are employed. Additives contained therein do not necessarily prevent foam from forming but rather cause it to break rapidly once it has formed.

The use of quality lubricants of the viscosity recommended by the machine manufacturer will assure long, trouble-free operation.

DUAL PURPOSE OILS

Mention has already been made of a condition that may exist in these automatic machines, namely the leakage of the machine lubricant into the coolant system and to a lesser extent, leakage of the coolant into the lubricating system. Although this does not always occur on every machine, it happens more frequently than not and becomes more prevalent as the machine becomes older. The effects of such a condition are almost self-evident. Continual dilution of the cutting oil with a common machine lubricant ultimately will reduce the percentage of active ingredients in the cutting oil to the point where it is no longer effective as a coolant. On the other hand, dilution of the lubricant by some types of cutting oils can promote sludge formation and corrosion and eventually ruin machine parts.

Petroleum companies took this problem to the laboratory and came up with the answer in the development of a Dual Purpose Oil which can be used as both a general machine lubricant and a coolant. These oils combine the characteristics of a good lubricating oil together with certain properties which are essential to a cutting oil but which are not injurious to the machine parts.

A machine using a conventional cutting oil as a lubricant would bog down in short order due to corrosion of the parts and gum formation. A bonafide Dual Purpose Oil will not corrode the copper or steel parts in the machine and will keep them clean and free from gum and sludge.

On the other hand, a common machine lubricant would prove to be quite inadequate if it were used as cutting oil. A Dual Purpose Oil, however, is so compounded as to give good tool performance and surface finish on most of the machining operations performed on the Automatics. Even on tough jobs which require a more highly compounded cutting oil, there is an advantage in using a Dual Purpose Oil as the lubricant. The effect of diluting the coolant with the lubricant would not be nearly as serious as if a conventional machine lubricant had been employed.

One word of caution regarding the use of Dual Purpose Oils: It is essential that only fresh, clean oil be added to the lubricating side of the machine. Oil from the coolant reservoir should never be added to the lubricant reservoir, since the chips and fine metal particles contained therein would cause serious damage to the bearings.

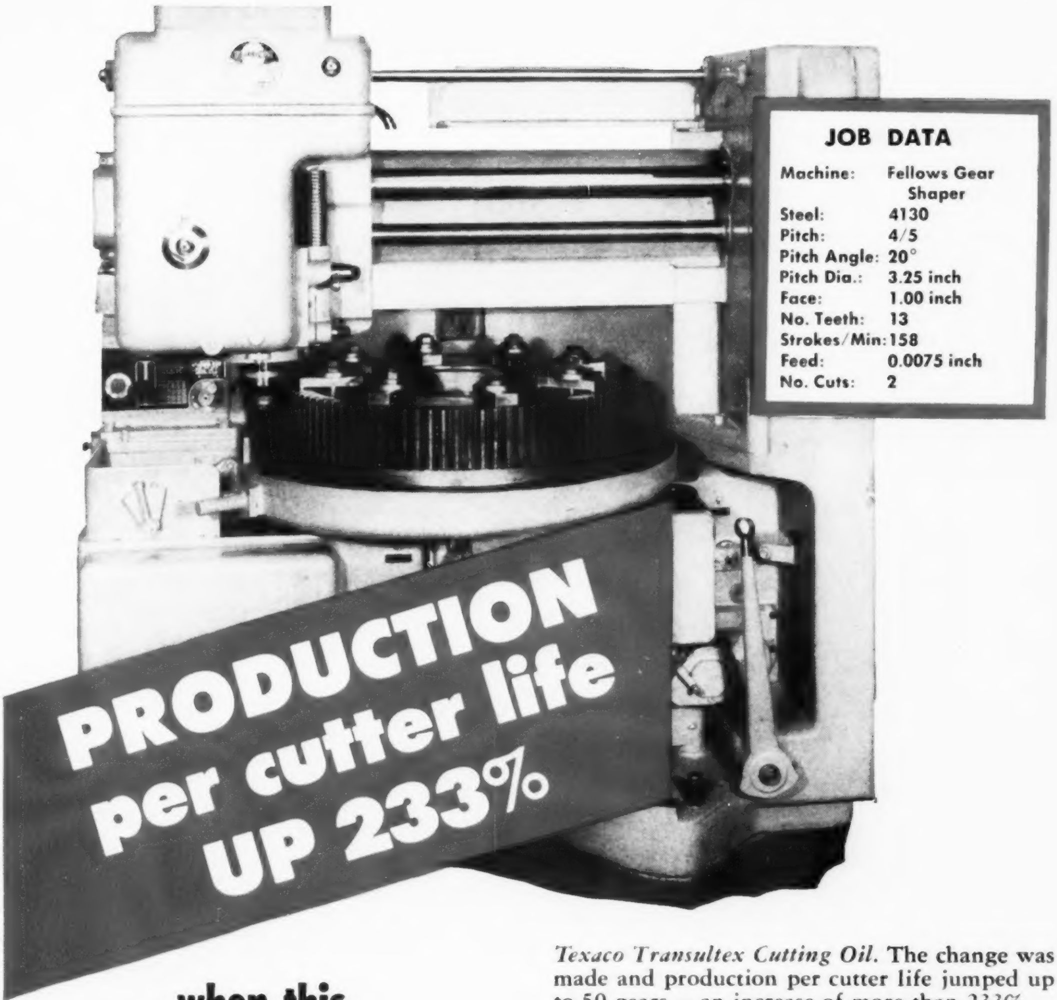
A Dual Purpose Oil should not be regarded as a cutting oil that can be used as a lubricant or as a lubricant that can be used as a cutting oil. This would infer that the oil was designed for one given purpose but can be substituted for another. Dual Purpose Oils were designed to be both a lubricant and a coolant, and the backlog of experience that has been developed over the years is a fitting testimony to their efficiency and value when used in the Automatics.

SUMMARY

Automatic screw or bar machines are a most vital factor in the metal cutting industry today. Each individual machine is a virtual production plant in itself and can produce an almost infinite variety of parts at an unbelievable rate from bars of both the conventional and special metals and alloys.

Needless to say, without suitable and adequate lubrication of the hundreds of moving parts, these machines would soon clatter to a sudden stop. The machine manufacturers have recognized the importance of lubrication to the successful operation of their machines and have equipped them with central systems which automatically provide for distribution of the lubricant to most of the parts. The Petroleum Industry has contributed to the lubrication picture by making available premium grade machine lubricants so compounded as to insure long-time, trouble-free service. Of particular interest to the manufacturers and users of the automatic screw machines are the Dual Purpose Oils, developed especially for use as both a lubricant and coolant on these machines.

Printed in U. S. A. by
Salley & Collins, Inc.
305 East 45th Street
New York 17, N. Y.



JOB DATA

Machine:	Fellows Gear Shaper
Steel:	4130
Pitch:	4/5
Pitch Angle:	20°
Pitch Dia.:	3.25 inch
Face:	1.00 inch
No. Teeth:	13
Strokes/Min:	158
Feed:	0.0075 inch
No. Cuts:	2

. . . when this manufacturer* changed to TEXACO TRANSULTEX CUTTING OIL

LIFE span of a gear cutter was never more than 15 gears — often less — when a well-known mining machinery manufacturer was using a competitive cutting oil. A Texaco Lubrication Engineer, called in for consultation, surveyed the entire set-up and recommended use of *Texaco Transultex Cutting Oil.* The change was made and production per cutter life jumped up to 50 gears — an increase of more than 233%.

There were other benefits, too. With *Texaco Transultex Cutting Oil,* 0.005" less stock had to be removed on tool regrinds. The transparency of *Texaco Transultex Cutting Oil* made inspection easier, reduced rejects. Cutter costs were substantially lowered.

Whatever the metal or your method of machining it, there are *Texaco Cutting, Grinding and Soluble Oils* to enable you to do every job better, faster, and at lower cost.

Let a Texaco Lubrication Engineer help you. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

**Name on request*

TEXACO

TEXACO CUTTING, GRINDING AND SOLUBLE OILS FOR FASTER MACHINING

Cut <u>any</u> metal, <u>any</u> way BETTER, FASTER, AT LOWER COST

THE examples* below show how Texaco Cutting Coolants – backed by the know-how of Texaco Lubrication Engineers – can help you do your machining –

BETTER – On this drilling job, a .040″ hole had to be reamed and held to plus or minus .0002″. Change from a competitive oil to *Texaco Cleartex Cutting Oil* reduced rejects 30%.

FASTER – In the production of a slotted part on a Davenport 5-spindle automatic, the better cooling and lubrication provided by the recommended Texaco Cutting Fluid resulted in an increase of 875 pieces per 8-hour shift.

AT LOWER COST – Reduction in downtime, after switching to *Texaco Sultex Cutting Oil*, saved $245 a month – on just one machine.

Let a Texaco Lubrication Engineer, specializing in metal working, help you step up production and reduce your machining costs. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

☆ ☆ ☆

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

*Names and details on request

THE TEXAS COMPANY • TEXACO PRODUCTS • DIVISION OFFICES

ATLANTA 1, GA., 864 W. Peachtree St., N.W.
BOSTON 17, MASS.............20 Providence Street
BUFFALO 3, N. Y.........14 Lafayette Square
BUTTE, MONT.........220 North Alaska Street
CHICAGO 4, ILL......332 So. Michigan Avenue
DALLAS 2, TEX...............311 South Akard Street
DENVER 5, COLO...........1570 Grant Street
HOUSTON 1, TEX........720 San Jacinto Street
INDIANAPOLIS 1, IND., 3521 E. Michigan Street
LOS ANGELES 15, CAL....929 South Broadway
MINNEAPOLIS 3, MINN....1730 Clifton Place
NEW ORLEANS 12, LA...........1501 Canal Street
NEW YORK 17, N. Y.....205 East 42nd Street
NORFOLK 1, VA....Olney Rd. & Granby Street
SEATTLE 11, WASH........1511 Third Avenue

TEXACO

Texaco Petroleum Products are manufactured and distributed in Canada by McColl-Frontenac Oil Company Limited.